October 20, 1982

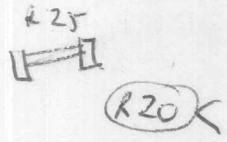
SPECIFICATIONS

FOR

OPTREX DOT MATRIX MODULE DMC SERIES

TYPE OF MODULE

DMC16106A	16 CHARACTERS 1 LINE
DMC16106B	16 CHARACTERS 1 LINE
DMC16106C	16 CHARACTERS 1 LINE
DMC16207	16 CHARACTERS 2 LINES
DMC20215	20 CHARACTERS 2 LINES
DMC32216	32 CHARACTERS 2 LINES
DMC40209	40 CHARACTERS 2 LINES



Data in this specifications are subject to change without notice. Please confirm latest specifications before designing.

GENERAL

OPTREX's Liquid Crystal Dot Matrix Display Module DMC Series can easily be connected to a micro computer by using LSI's which contain sophisticated control circuits, character generators, etc.

FEATURES

(1) 5 x 7 dots and cursor display (Only DMC16106A available for use with 5 x 10 dots and cursor display.)

(2) 8-bit or 4-bit MPU interface is available.

(3) 160 JIS type characters such as Alphabet, Numeral and Kana and 32 special characters and symbols can be displayed by internal character generator (ROM).

(4) Random symbols can be displayed by internal character generator (RAM).

(5) Many instructional functions by means of program such as "clear display", "home cursor", "on/off cursor", "blink character", "shift display", "shift cursor", "read/write display data", etc. are available.

(6) Compact and light weight design enables easy assem-

bly on device.

(7) Single "+5V" power supply.

(8) Low power consumption

(9) DMC Series is most suitable for use with micro computer peripheral, word processor, POS terminal and telecommunication systems etc.

ELECTRICAL CHARACTERISTICS

V_{CC} = 5.0V ± 5%, Ta = 25°C

Item	Symbol	Test Condition	Standard Value			Unit
			min.	typ.	max.	
Input "High" Voltage	V_{IH}	-	2.2	-	V_{CC}	V
Input "Low" Voltage	V_{IL}	-	-0.3	-	0.6	V
Output "High" Voltage	V_{OH}	$-I_{OH}$ = 0.205mA	2.4	-	-	V
Output "Low" Voltage	V_{OL}	I_{OL} = 1.2mA	-	-	0.4	V
Power Supply Current	I_{CC}	V_{CC} = 5.0V	-	0.5	5	mA

ABSOLUTE MAXIMUM RATINGS

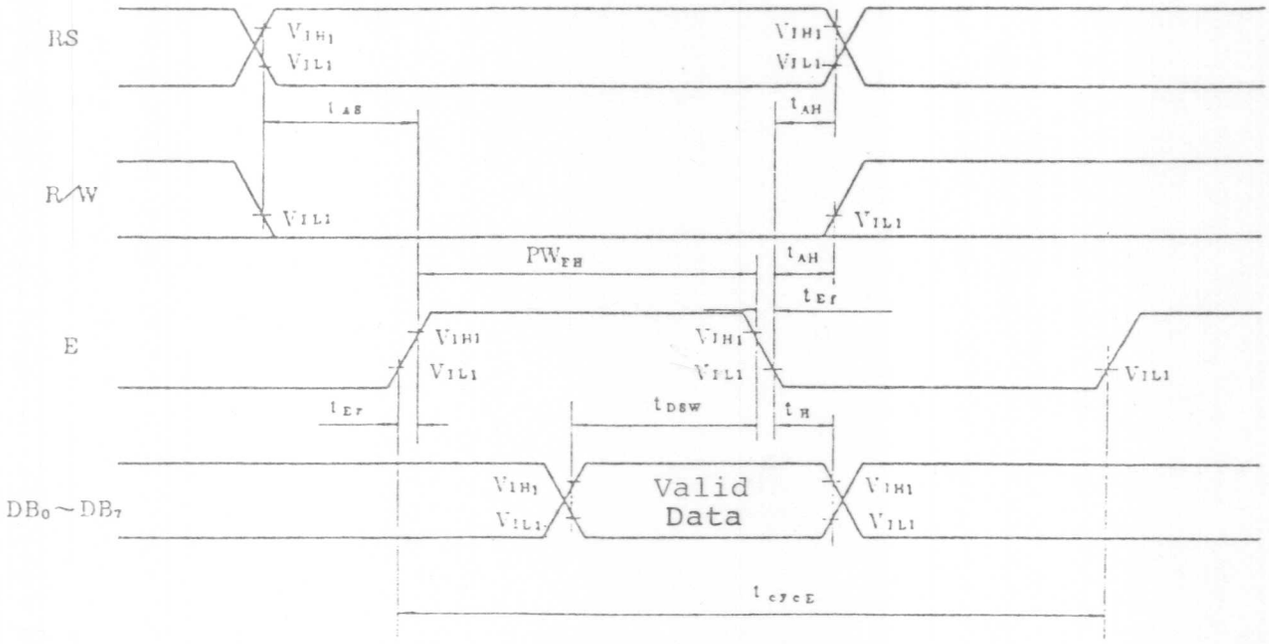
Item	Symbol	Test Condition	Standard Value			Unit
			min.	typ.	max.	
Power Supply Voltage for Logic	$V_{CC} - V_{SS}$	-	0	-	7	V
Power Supply Voltage for LCD Drive	$V_{CC} - V_{ee}$	-	0	-	13.5	V
Input Voltage	V_I	-	V_{SS}	-	V_{CC}	V
Operating Temperature	Ta		0	-	+50	°C
Storage Temperature	Tstg		-20	-	+70	°C

TIMING CHART

V_{CC} = 5.0V ± 5%, Ta = 25°C

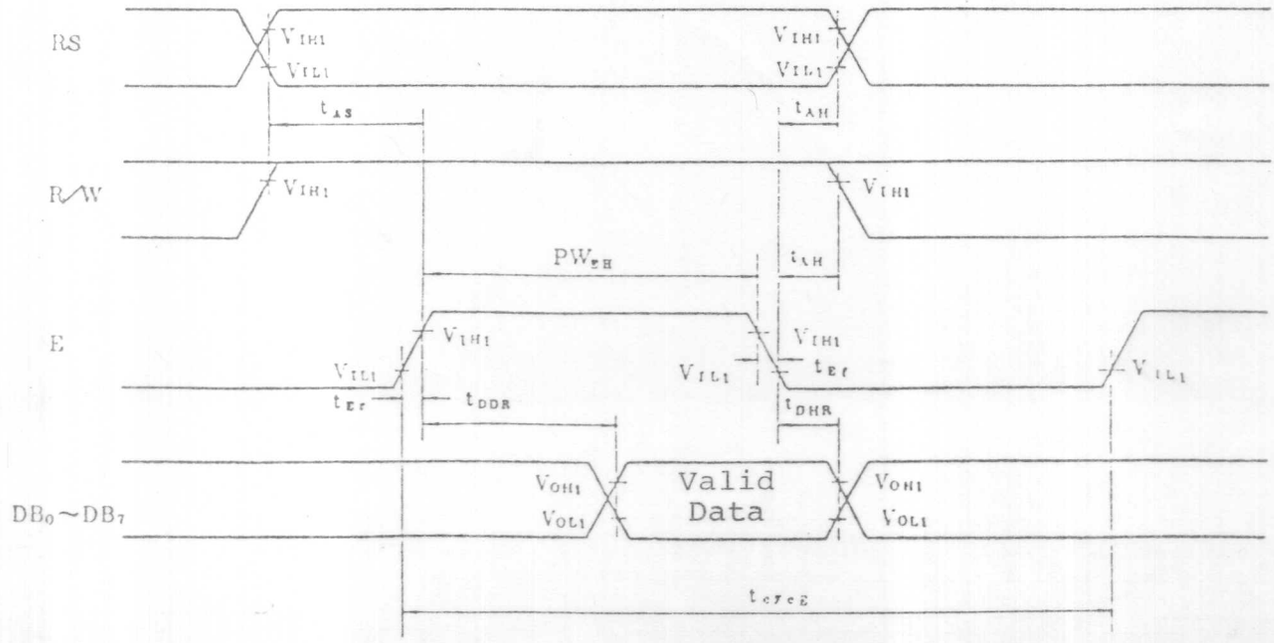
Item	Symbol	Measuring Condition	Standard Value			Unit
			min.	typ.	max.	
Enable Cycle Time	$T_{cyc}E$	See Figs. 1 and 2	1000	-	-	nS
Enable Pulse Width, High Level	PW_{EH}	See Figs. 1 and 2	450	-	-	nS
Enable Rise and Fall Time	t_{Er} t_{Ef}	See Figs. 1 and 2	-	-	25	nS
Address Setup Time, RS, R/W-E	t_{AS}	See Fig. 1 and 2	140	-	-	nS
Data Delay Time	t_{DDR}	See Fig. 2	-	-	320	nS
Data Setup Time	t_{DSW}	See Fig. 1	195	-	-	nS
Data Hold Time	t_{H}	See Fig. 1	10	-	-	nS
Data Hold Time	t_{DHR}	See Fig. 2	20	-	-	nS
Address Hold Time	t_{AH}	See Figs. 1 and 2	10	-	-	nS

FIG. 1 WRITE OPERATION



(Write Data from MPU to MODULE)

FIG. 2 READ OPERATION



(Reading Data from MODULE to MPU)

OPTICAL CHARACTERISTICS

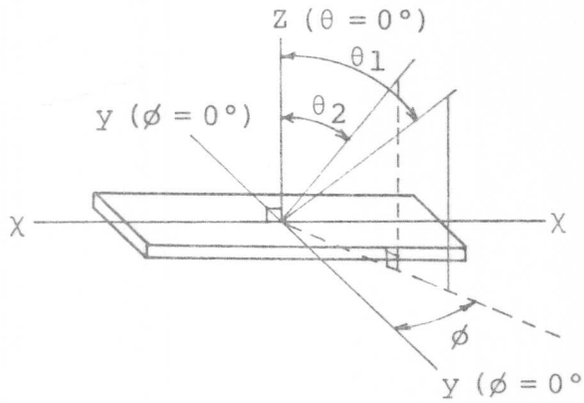
V_{CC} = 5.0V ± 5%, Ta = 25°C

Item	Symbol	Test Condition	Standard Value			Unit
			min.	typ.	max.	
Liquid Crystal Drive Voltage (Recommended value) 1/8 duty	V_{CC} - Vee (V_D)	Ta=0°C	4.0	-	-	V
		Ta=25°C	-	4.1	-	V
		Ta=50°C	-	-	4.2	V
Visual Angle Range	θ_1-θ_2	C_R=3	30	-	-	deg.
Contrast Ratio	C_R	θ_2=20°, ϕ=0°	10	-	-	
Rise Time	τr	V_D=4.1V, θ=20°	-	100	200	mS
Decay Time	τd	V_D=4.1V, θ=20°	-	100	200	mS

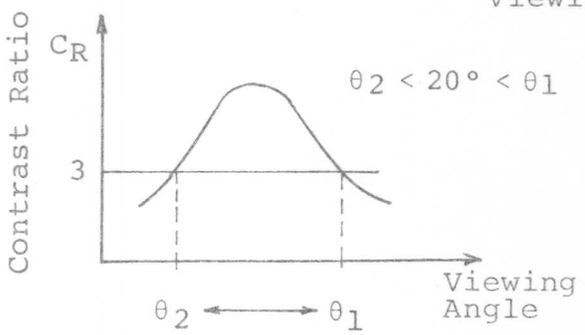
Liquid Crystal Drive Voltage (Recommended Value) 1/11 duty	V_{CC} - Vee (V_D)	Ta=0°C	4.4	-	-	V
		Ta=25°C	-	4.5	-	V
		Ta=50°C	-	-	4.6	V
Visual Angle Range	θ_1-θ_2	C_R=3	25	-	-	deg.
Contrast Ratio	C_R	θ_2=20°, ϕ=0°	8	-	-	
Rise Time	τr	V_D=4.5V, θ=20°	-	120	240	mS
Decay Time	τd	V_D=4.5V, θ=20°	-	120	240	mS

Item	Symbol	Test Condition	Standard Value			Unit
			min.	typ.	max.	
Liquid Crystal Drive Voltage (Recommended Value) 1/16 duty	V_{CC} - Vee (V_D)	Ta=0°C	4.7	4.8	4.9	V
		Ta=25°C	4.4	4.5	4.6	V
		Ta=50°C	4.1	4.2	4.3	V
Visual Angle Range	θ_1-θ_2	C_R=3	20	-	-	deg.
Contrast Ratio	C_R	θ_2=20°C, ϕ=0°	6	-	-	
Rise Time	τr	V_D=4.5V, θ=20°	-	120	240	mS
Decay Time	τd	V_D=4.5V, θ=20°	-	120	240	mS

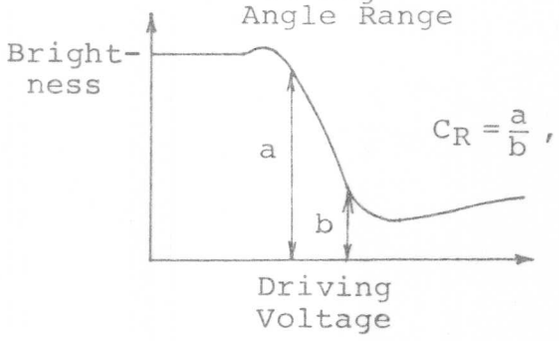
NOTE:



Definition of Viewing Angle θ and ϕ



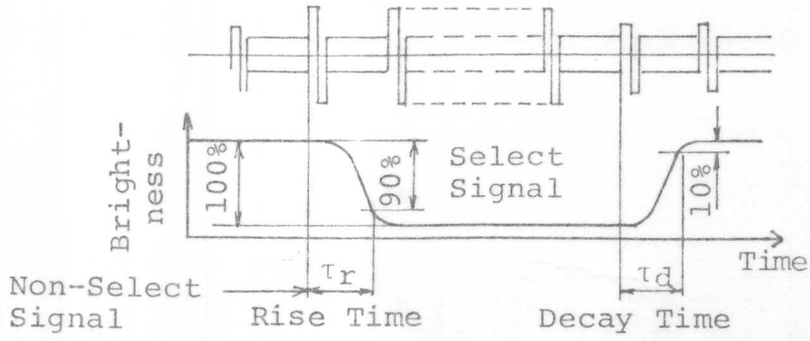
Definition of Viewing Angles θ_2 and θ_1



a: Brightness in non select signal

b: Brightness in select signal

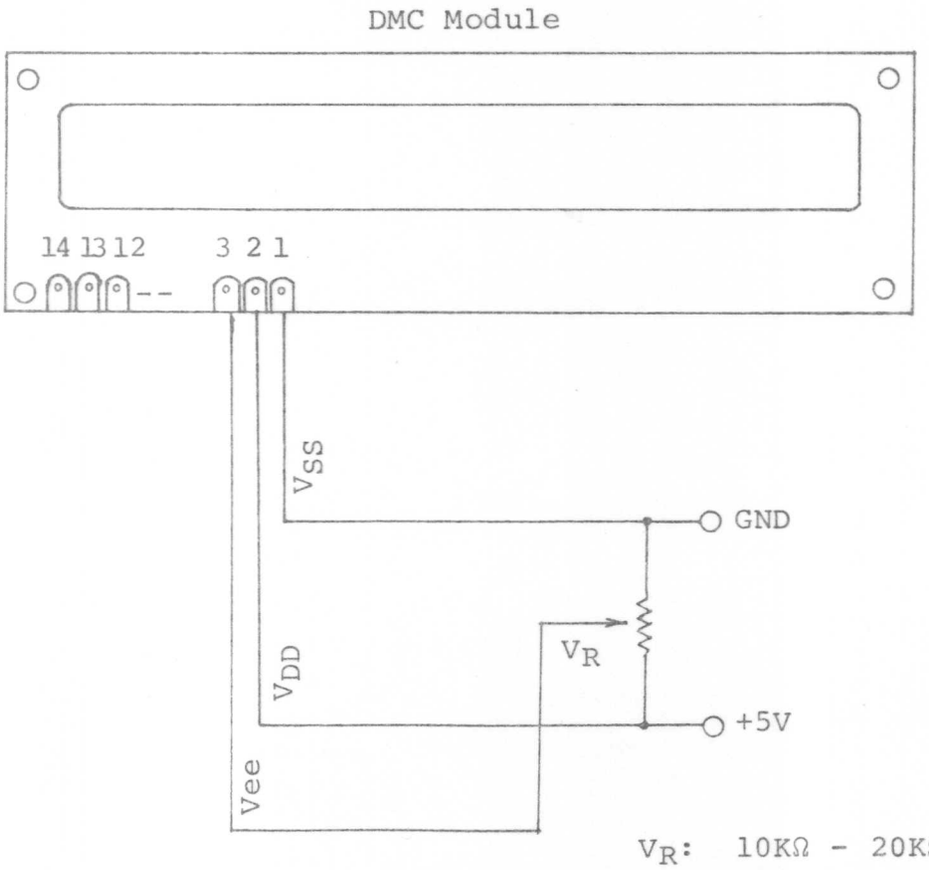
Definition of Contrast Ratio C_R



Definition of Optical Response Time

Those time that the brightness of lighting segment reaches 90% from 0% is τ_r and that reaches 10% from 100% is τ_d.

EXAMPLE OF POWER SUPPLY



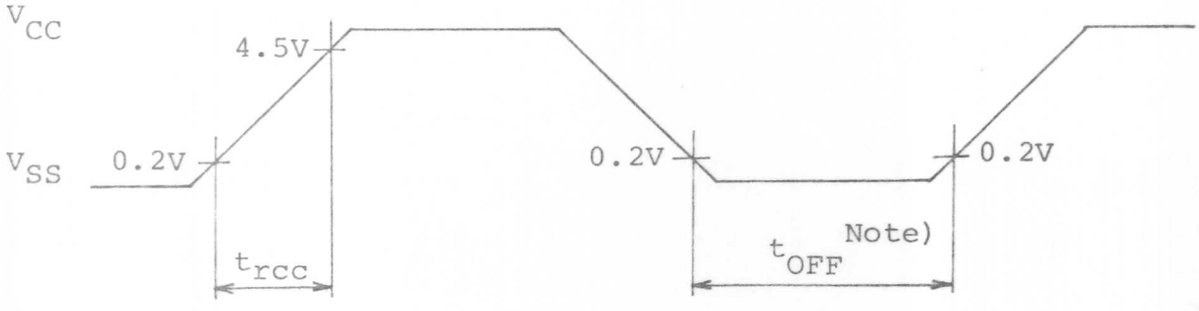
V_R: 10KΩ - 20KΩ

Note: When the voltage of Vee is different from the recommended voltage, the viewing angle may be changed.

POWER SUPPLY RESET

The internal reset circuit will not be correctly operated, when the following power supply condition is not satisfied. In this case, please perform initial setting according to the instruction.

Item	Sym-bol	Measuring Condition	Standard Value			Unit
			min.	typ.	max.	
Power Supply Rise Time	t_{rcc}	-	0.1	-	10	mS
Power Supply OFF Time	t_{OFF}	-	1	-	-	mS

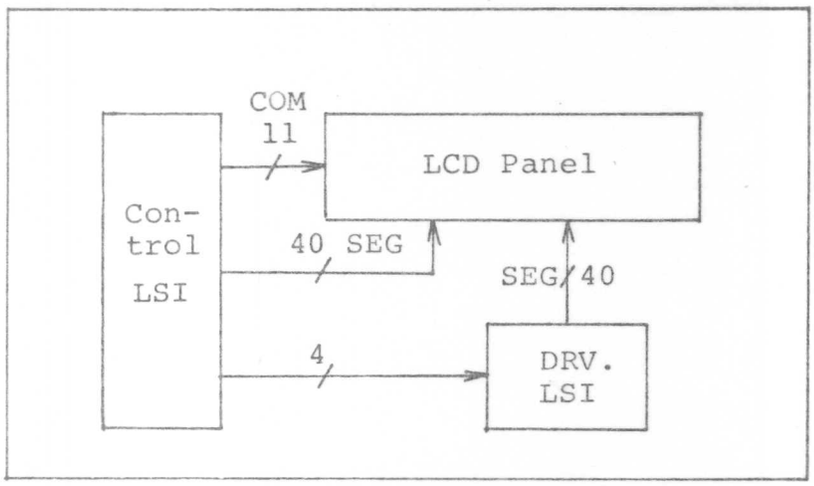


$0.1mS \leqq t_{rcc} \leqq 10mS$ $\quad t_{OFF} \geqq 1mS$

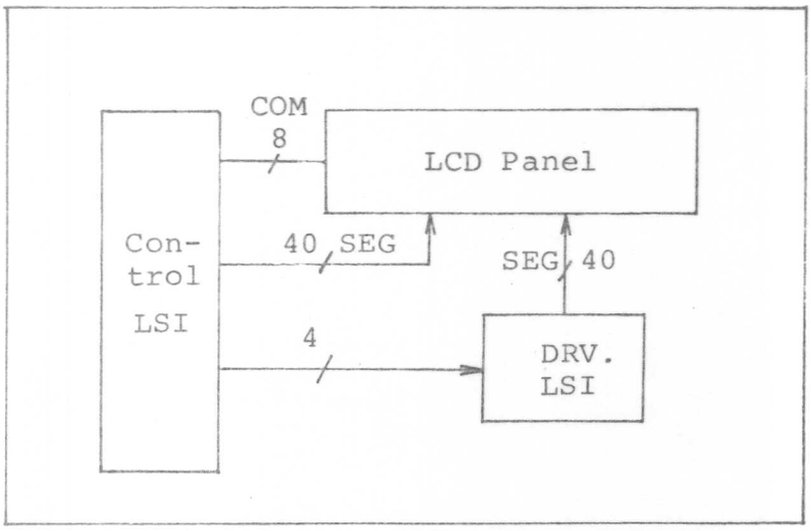
Note: The item t_{OFF} defines the time when the power supply is off, when the power supply shuts down momentarily or repeats on-off state.

BLOCK DIAGRAM

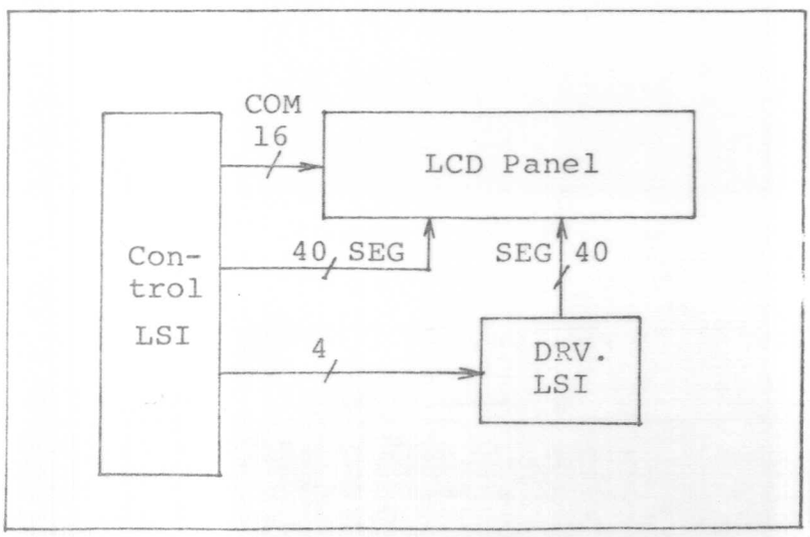
DMC16106A



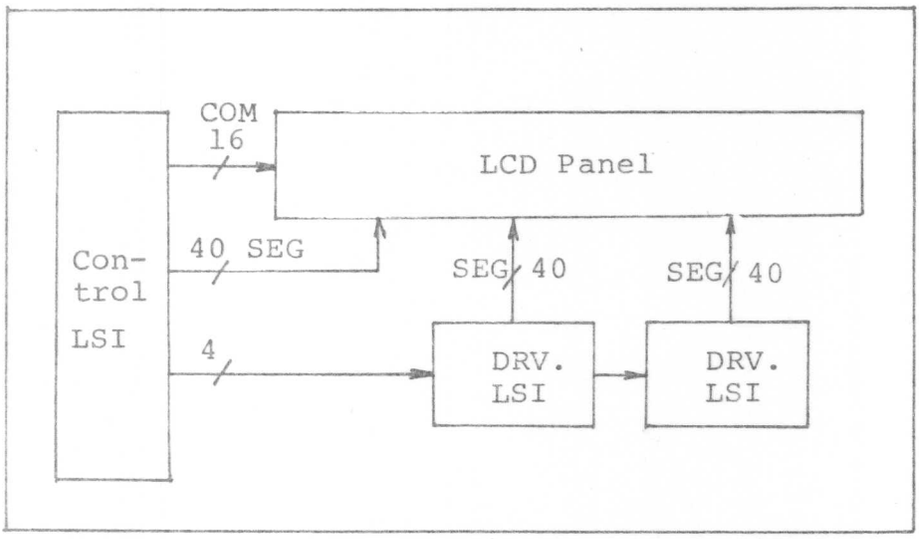
DMC16106B
DMC16106C



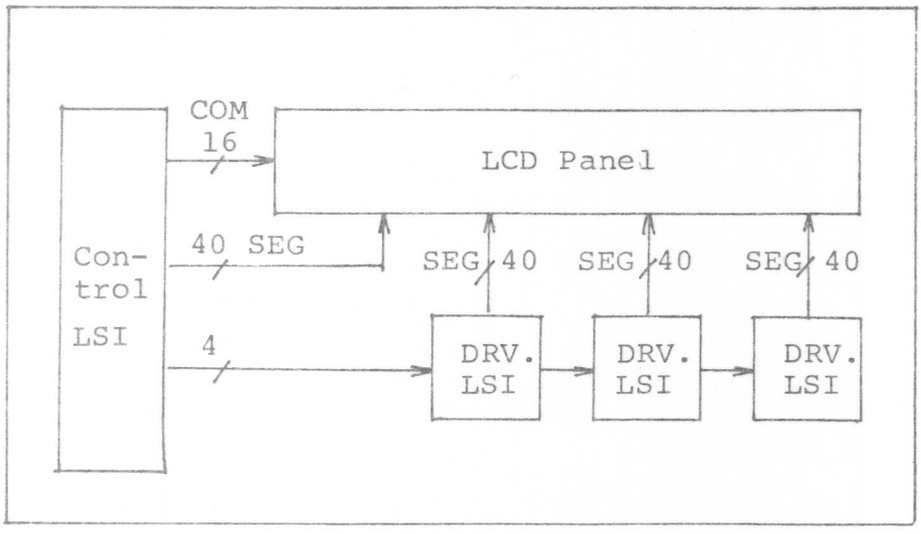
DMC16207



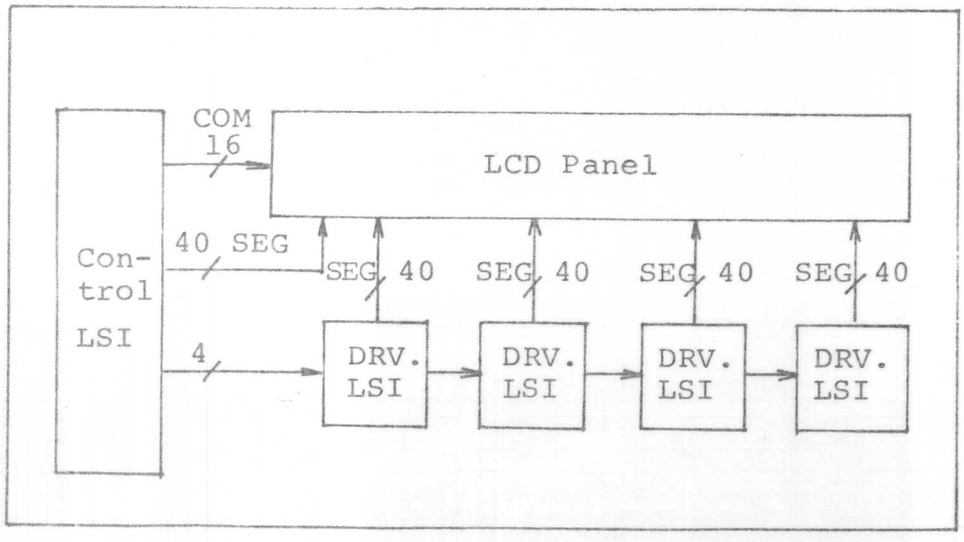
DMC20215



DMC32216



DMC40209



INSTRUCTIONS

Instruction	Code										Description	Execute Time (max.)
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Clears all display and returns the cursor to the home position (Address 0).	1.64 mS
Cursor At Home	0	0	0	0	0	0	0	0	1	*	Returns the cursor to the home position (Address 0). Also returns the display being shifted to the original position. DD RAM contents remain unchanged.	1.64 mS
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Sets the cursor move direction and specifies or not to shift the display. These operations are performed during data write and read.	40 µS
Display On/Off Control	0	0	0	0	0	0	1	D	C	B	Sets ON/OFF of all display (D) cursor ON/OFF (C), and blink of cursor position character (B).	40 µS
Cursor/ Display Shift	0	0	0	0	0	1	S/C	R/L	*	*	Moves the cursor and shifts the display without changing DD RAM contents.	40 µS
Function Set	0	0	0	0	1	DL	N	F	*	*	Sets interface data length (DL) number of display lines (L) and character font (F).	40 µS
CG RAM Address Set	0	0	0	1	A_{CG}						Sets the CG RAM address. CG RAM data is sent and received after this setting.	40 µS
DD RAM Address Set	0	0	1	A_{DD}							Sets the DD RAM address. DD RAM data is sent and received after this setting	40 µS
Busy Flag/ Address Read	0	1	BF	AC							Reads Busy flag (BF) indicating internal operation is being performed and reads address counter contents.	40 µS
CG RAM/ DD RAM Data Write	1	0	WRITE DATA								Writes data into DD RAM or CG RAM.	40 µS
CG RAM/ DD RAM Data Read	1	1	READ DATA								Reads data from DD RAM or CG RAM.	40 µS

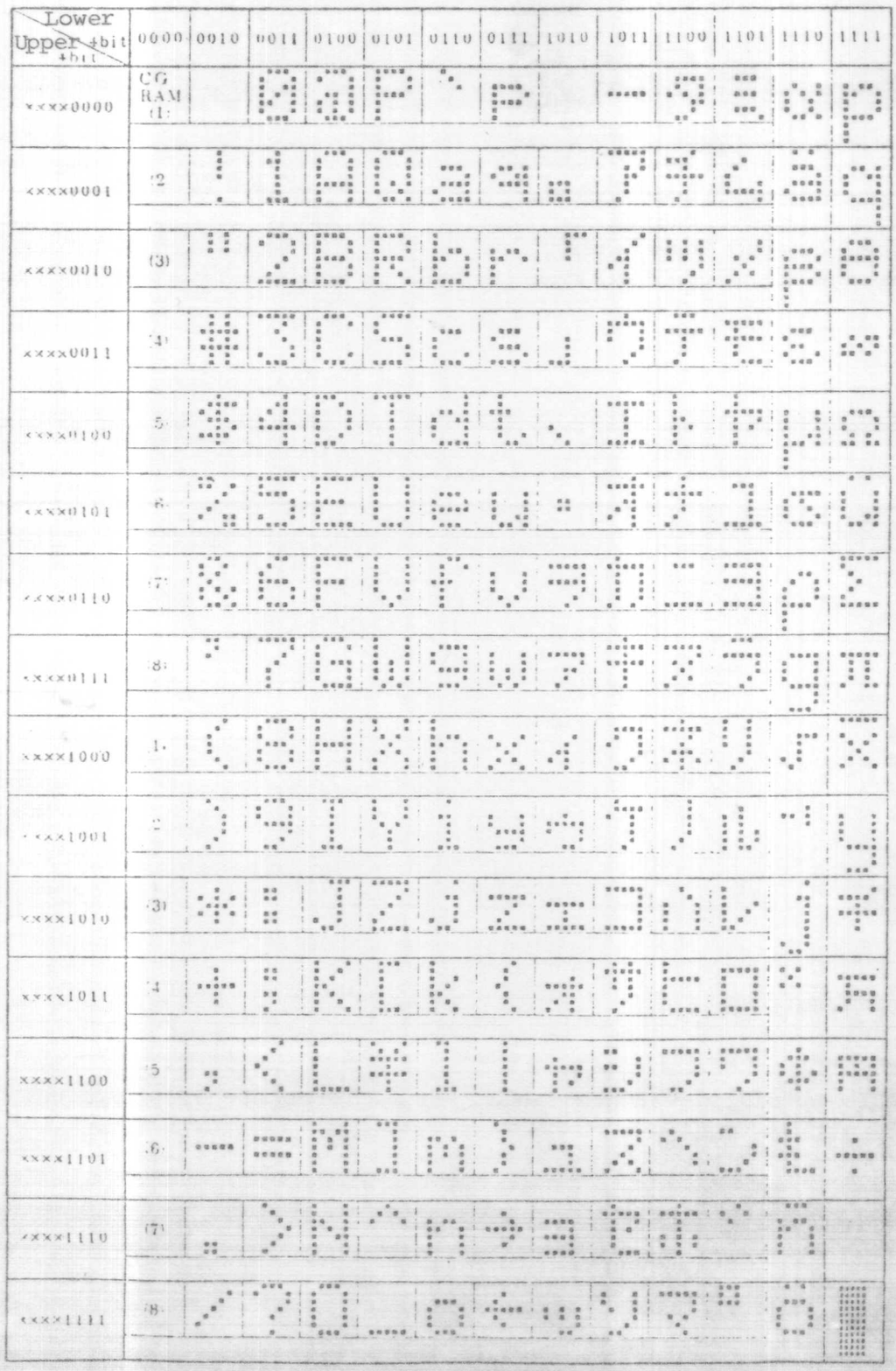
Note:

Code	Description	Execute Time (max.)
I/D=1: Increment I/D=0: Decrement S = 1 : With display shift S/C=1: Display shift S/C=0: Cursor movement R/L=1: Shift to the right R/L=0: Shift to the left DL = 1 8-bit DL = 0: 4-bit N = 1: 2 lines N = 0: 1 line F = 1: 5 x 10 dots F = 0: 5 x 7 dots BF = 1: Internal operation is being performed. BF = 0: Instruction acceptable.	DD RAM: Display Data RAM CG RAM: Character Generator RAM A_{CG}: CG RAM Address A_{DD}: DD RAM Address Corresponds to cursor address. AC: Address Counter, used for both DD RAM and CG RAM * : Invalid	fcp or fosc = 250KHz However, when frequency changes, execution time also changes. Ex. When fcp or fosc = 270KHz, $40\mu S \times \frac{250}{270} = 37\mu S$

Note: For details in program, refer to the User's Manual which is separately provided.

CHARACTER FONT TABLE

(Correspondence between Characters Codes and Character Pattern)



* CG RAM: Character pattern area which can freely be re-written by program.

PIN ASSIGNMENT

Pin No.	Sym-bol	Level	Function
1	V_{SS}	-	Power Supply Voltage 0V (GND)
2	V_{DD}	-	Power Supply Voltage +5V
3	Vee	-	Power Supply for Liquid Crystal Drive
4	RS	H/L	Register Select H: Data Input L: Instruction Input
5	R/W	H/L	H: Data Read (Module → MPU) L: Data Write (Module ← MPU)
6	E	H, H→L	Enable Signal
7	DB0	H/L	Data Bus Line
8	DB1	H/L	"
9	DB2	H/L	"
10	DB3	H/L	"
11	DB4	H/L	"
12	DB5	H/L	"
13	DB6	H/L	"
14	DB7	H/L	"

Note: In the data bus line, data transfer is performed two times by the 4-bit or one time by the 8-bit in order to interface with 4-bit or 8-bit MPU.

* In case interface data length is 4-bit

The data is transferred by using only four buses of DB4 - DB7 and the buses of DBϕ - DB3 are not

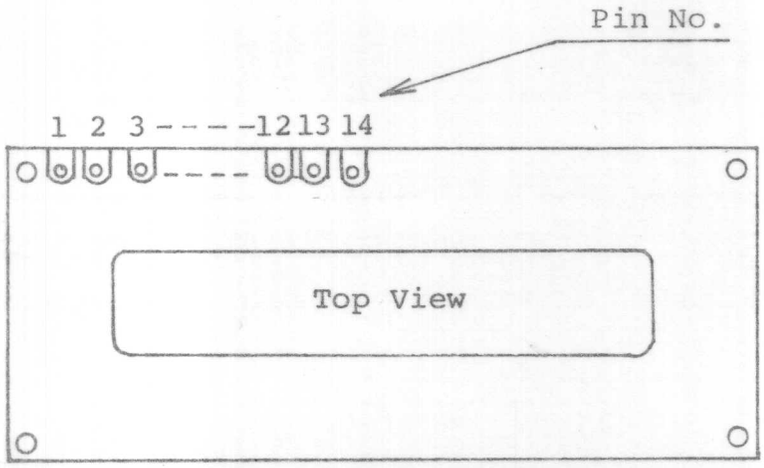
used. The data transfer to MPU is completed by transferring the data of 4 bits twice.

Transfer of upper four bits and low four bits is performed in sequence.

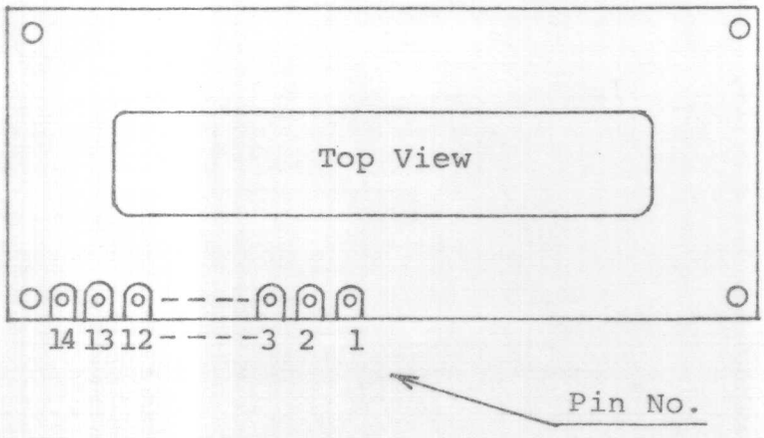
* In case interface data length is 8 bit,

Data transfer is performed by using eight buses of DB0 - DB7.

PIN-OUTS



DMC16106A
DMC16106C



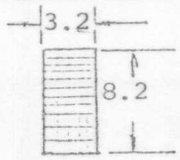
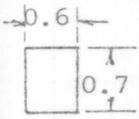
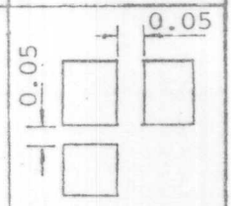
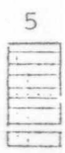
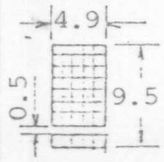
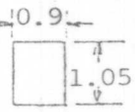
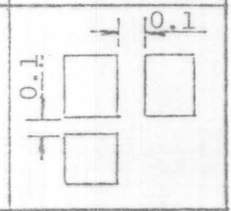
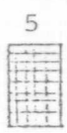
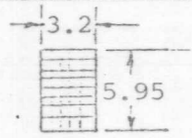
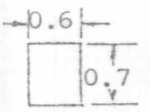
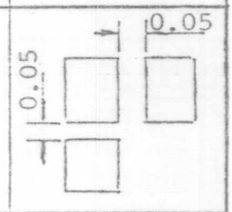
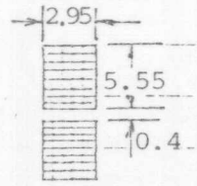
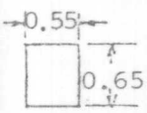
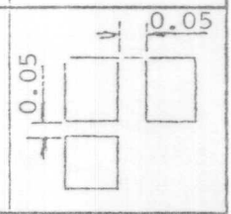
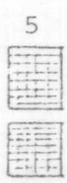
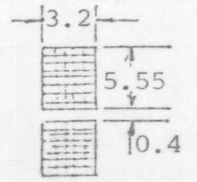
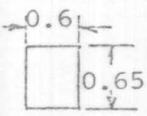
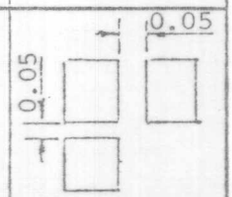
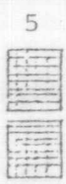
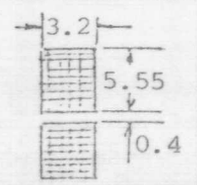
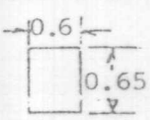
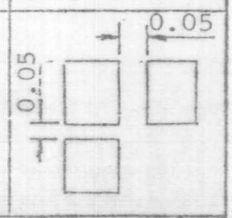
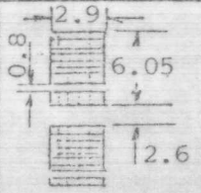
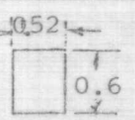
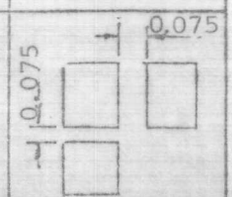
DMC16106B
DMC16207
DMC20215
DMC32216
DMC40209

DIMENSIONS

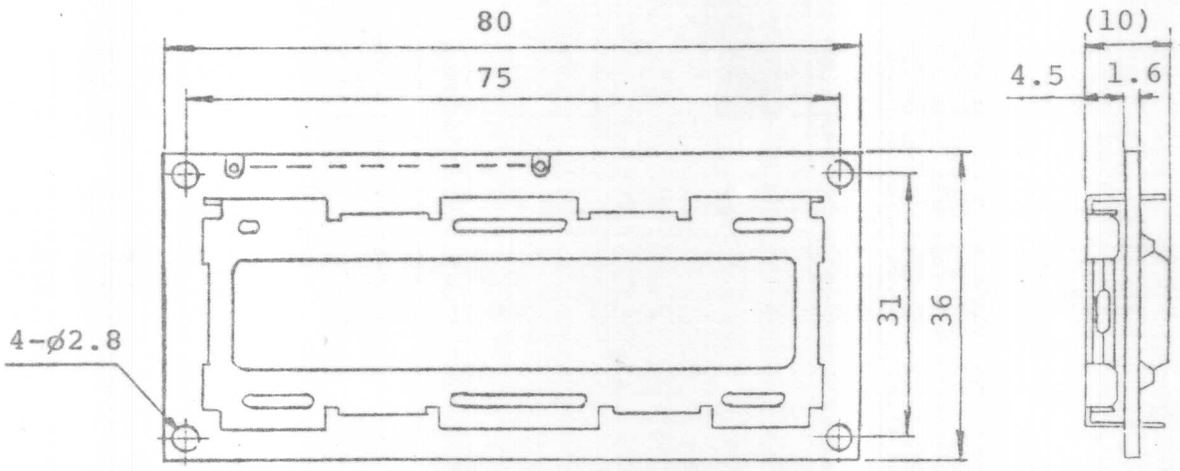
Item \ Module	DMC16106A	DMC16106B	DMC16106C	DMC16207	DMC20215	DMC32216	DMC40209
Number of characters	16 charters 1 line	16 charters 1 line	16 charters 1 line	16 charters 2 lines	20 charters 2 lines	32 charters 2 lines	40 charters 2 lines
Duty	1/11 or 1/8	1/8	1/8	1/16	1/16	1/16	1/16
Module Dimensions Length x Width x Thickness	80x36x10	130x44 x10	80x36x10	84x44x11	116x44 x11	175x44 x11	220x53 x10
View Area Dimensions Length x Width	64.5x13	99 x 13	64.5x13	61 x 16	83x18.6	130x 18.6	155x 19
Weight (g)	Approx. 28	Approx. 45	Approx. 28	Approx. 38	Approx. 45	Approx. 75	Approx. 90

(Unit: mm)

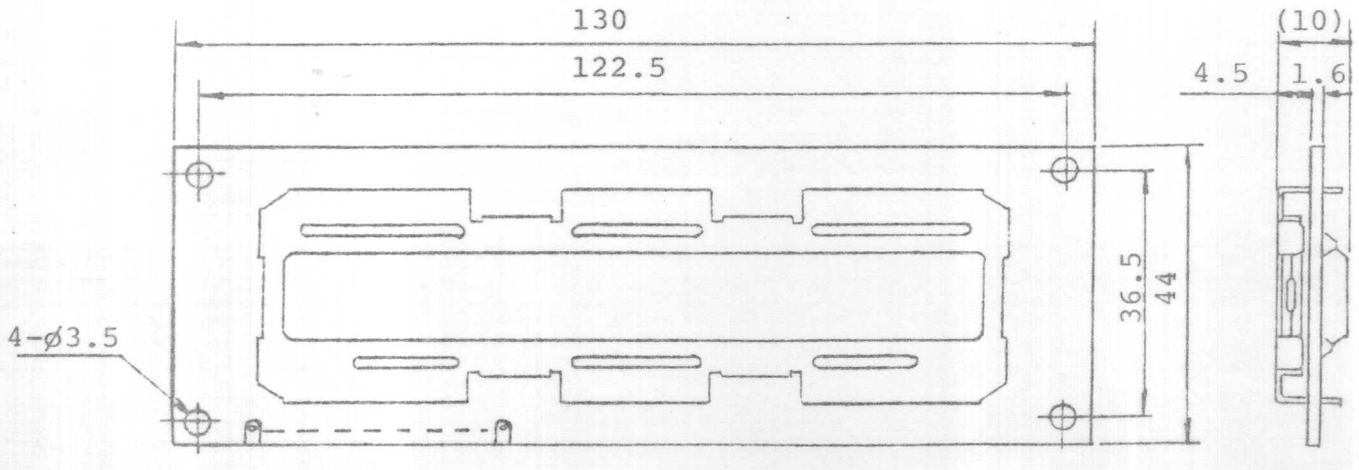
DISPLAY DOT PATTERN

Model Number	Character Configuration	Character Size	Dot Size	Dot Pitch
DMC16106A (16 characters 1 line)				
DMC16106B (16 characters 1 line)				
DMC16106C (16 characters 1 line)				
DMC16207 (16 characters 2 lines)				
DMC20215 (20 characters 2 lines)				
DMC32216 (32 characters 2 lines)				
DMC40209 (40 characters 2 lines)				
	No. of Dots	mm	mm	mm

DIMENSIONS



DMC16106A
DMC16106C



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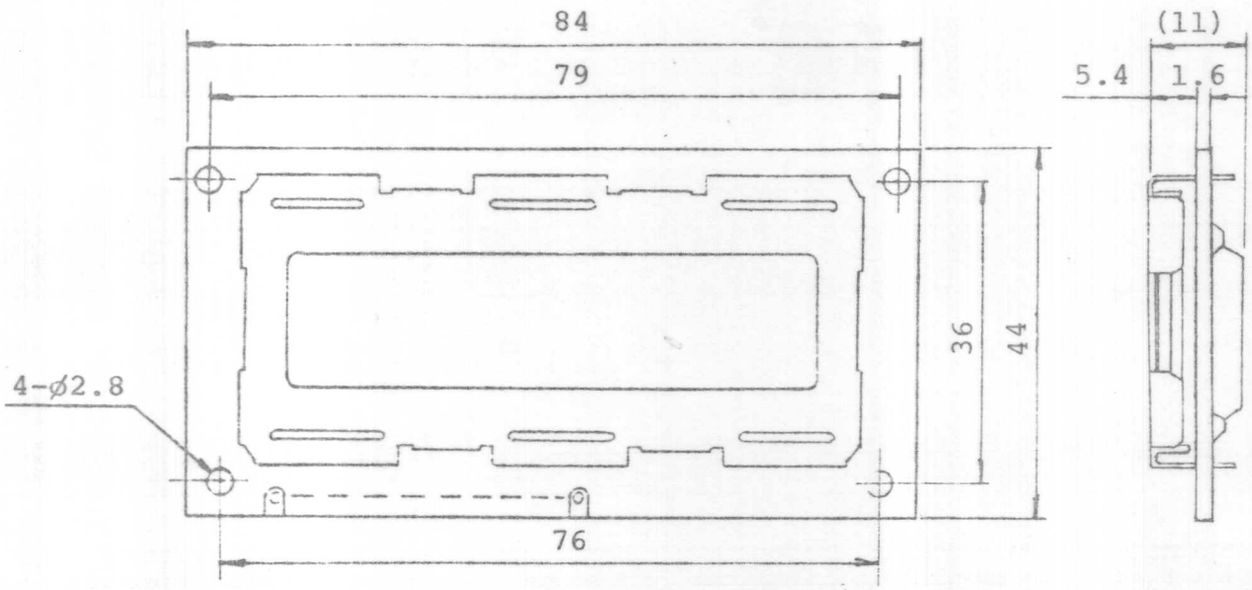

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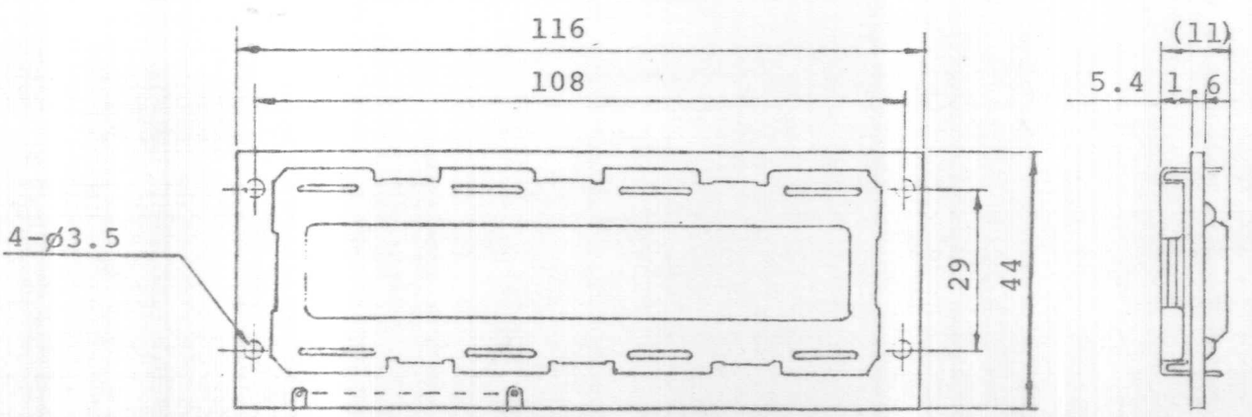

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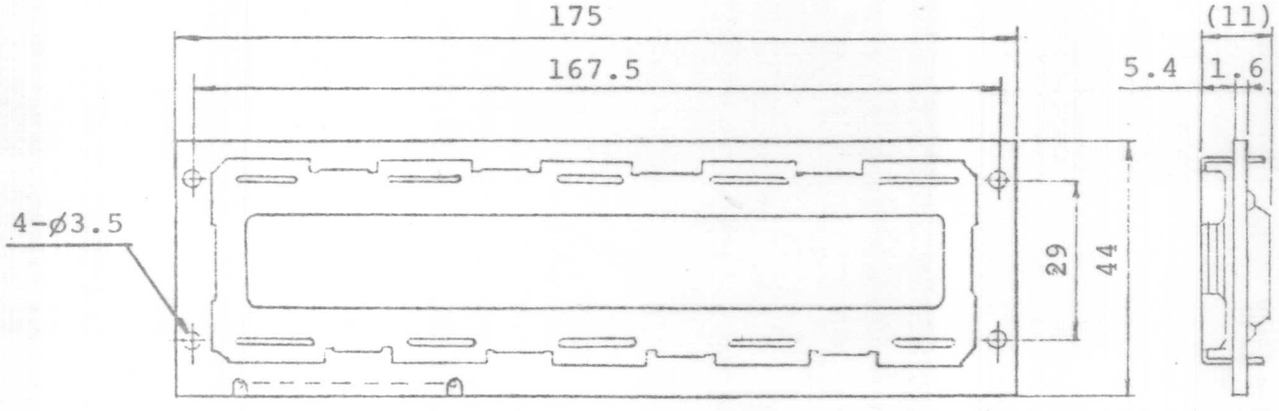
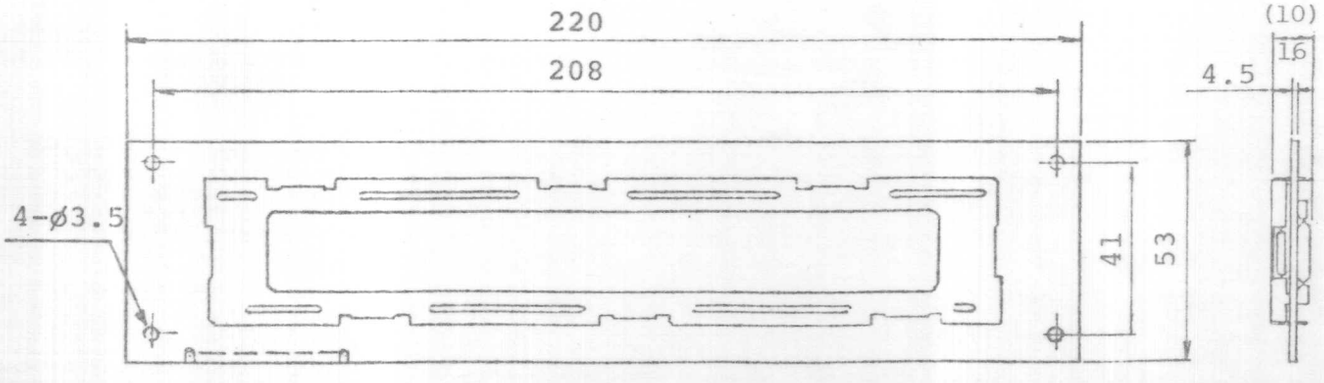


DMC32216



DMC40209